

Emotional Anatomy: Botulinum Toxin and the Regulation of Mood

Robert J. Vanaria^{1,2}; Aysham Chaudry, DO¹; Angelica Marrero-Perez, MD¹; Z. Paul Lorenc, MD³; Mark S. Nestor MD, PhD^{1,4,5}

1: Center for Clinical and Cosmetic Research, Aventura, FL; 2: Hackensack Meridian School of Medicine, Nutley, NJ; 3: Lorenc Aesthetic Plastic Surgery Center, New York, NY 4: Department of Dermatology and Cutaneous Surgery, University of Miami, Miller School of Medicine, Miami, FL; 5: Department of Surgery, Division of Plastic Surgery, University of Miami Miller School of Medicine, Miami, FL

BACKGROUND

Humans have evolved the ability to interpret emotions through facial expressions, which are driven by the contraction and relaxation of facial muscles in response to the limbic system. Specific muscle groups, such as the glabella and medial frontalis, produce expressions like frowning, often associated with negative emotions and mental health conditions like depression. Chronic frowning can result in characteristic wrinkles, such as the "omega sign," commonly seen in depressed individuals. Research highlights facial expressions as universal indicators of psychomotor states and key in understanding emotional experiences. The "facial feedback hypothesis" suggests that facial expressions influence emotions, with frequent frowning potentially reinforcing negative emotional states.

Botulinum toxin (BoNT-A), initially developed for medical purposes, has become widely used for cosmetic and therapeutic applications. By inducing temporary muscle paralysis, BoNT-A can reduce wrinkles and disrupt negative emotional feedback loops, potentially improving mood and reducing symptoms of depression and anxiety. This literature review explores the connection between facial anatomy, emotional expression, and the effects of BoNT-A on mood regulation, emphasizing its potential benefits beyond aesthetics.

METHODS

A literature review regarding understanding of facial anatomy and expressions as well as botulinum toxin's effect on emotions and communication was conducted via PubMed using search terms such as "botulinum toxin" AND "emotion". Results were screened for relevance and to include English-only articles. Further articles were included via citation tracking, and authors' clinical experience was also included.

RESULTS/DISCUSSION

Anatomy of Emotional Expression & Bio-Feedback

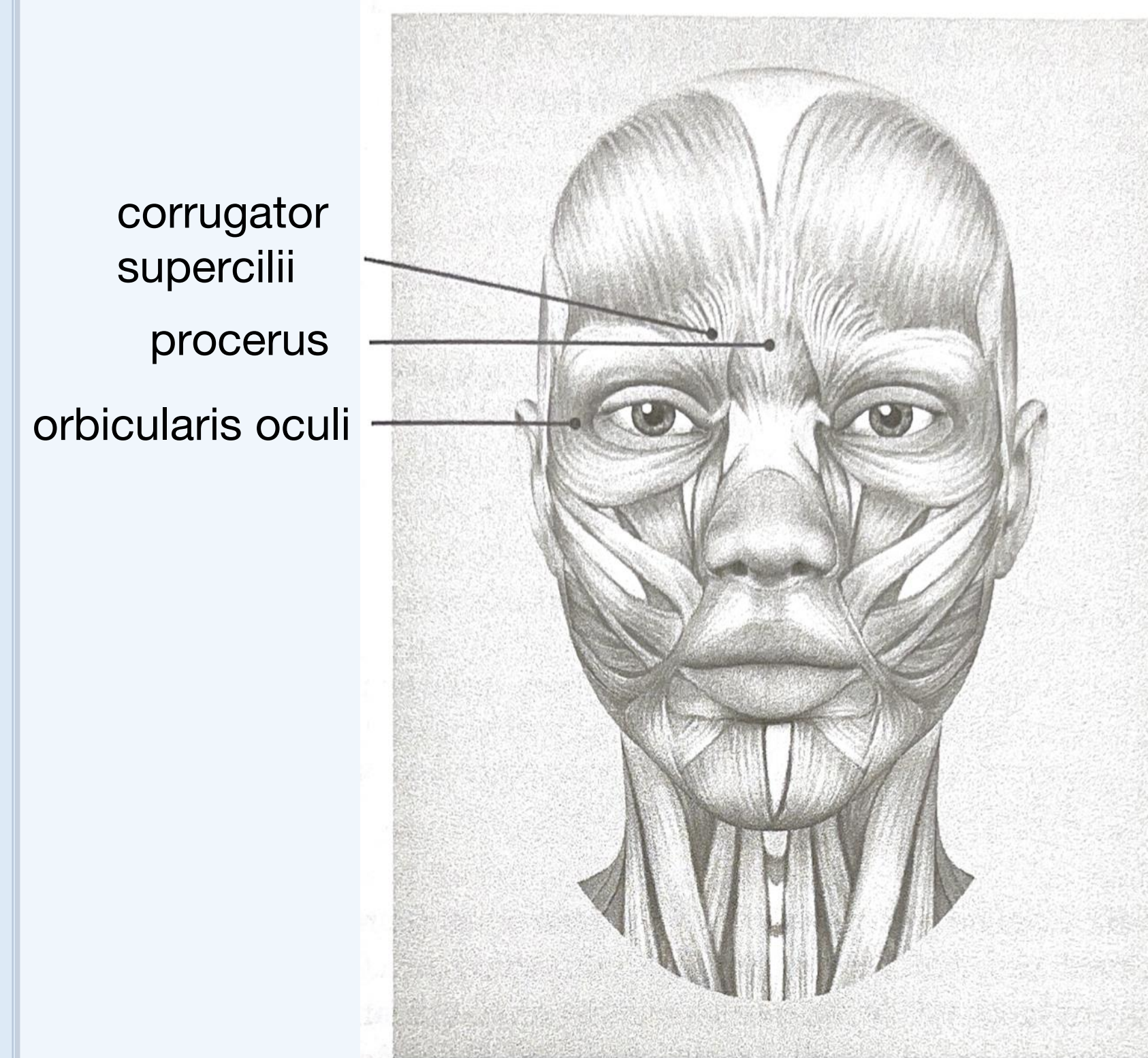


Figure 1. The glabellar region: corrugator and procerus muscles. Responsible for conveying negative emotions.

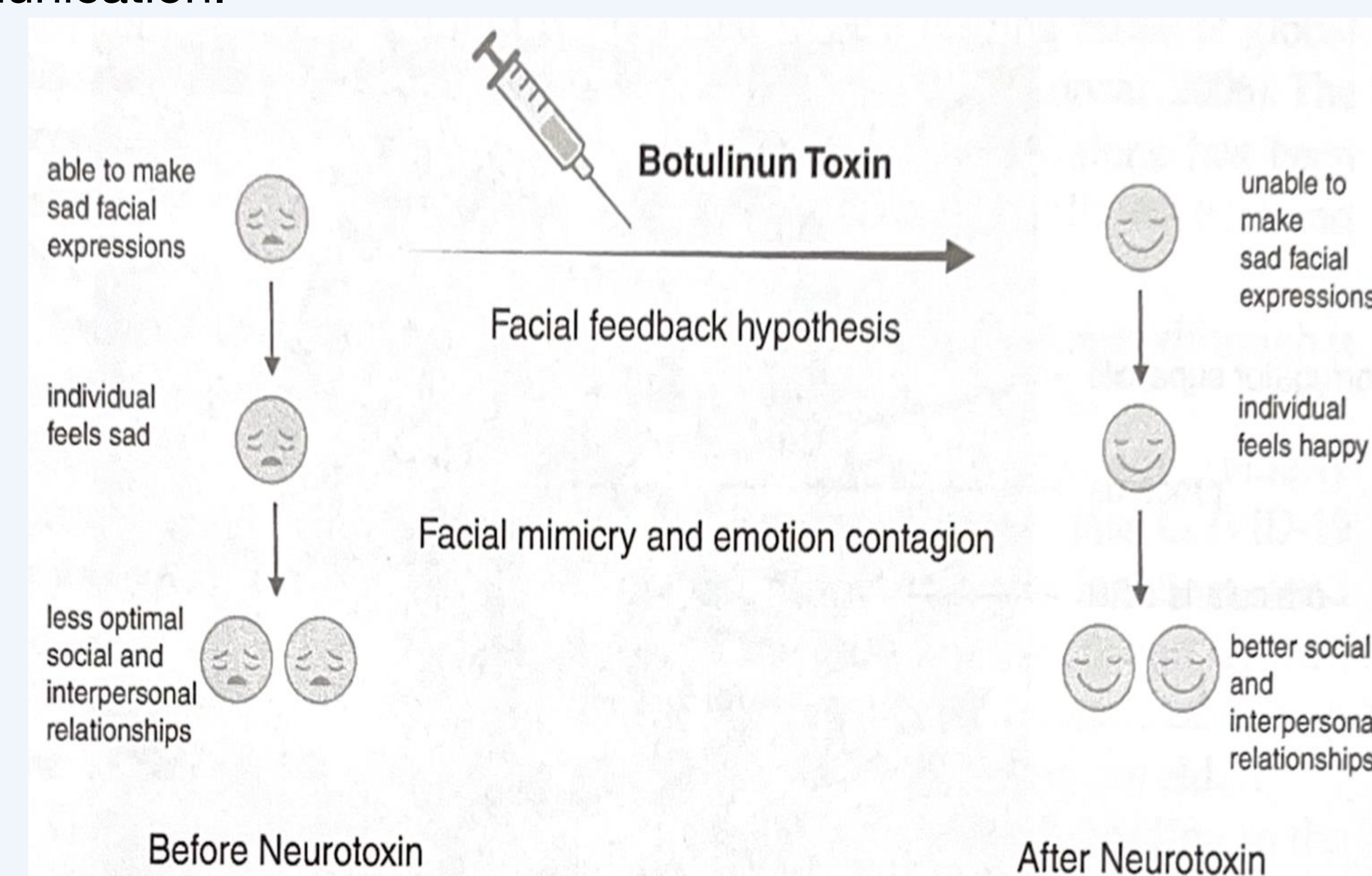
Frowning, driven by muscles like the procerus and corrugator supercilii, portrays negative emotions such as sadness, fear, and anger, and their prominence may signal mood disorders. Smiling, especially the genuine "Duchenne" smile involving the orbicularis oculi muscle, conveys happiness and strengthens emotional feedback. According to the facial feedback hypothesis, facial expressions influence emotional experience, as seen in studies where altered muscle activity impacted perceived

emotions. Emotional mimicry and contagion refers to the effects felt by someone observing a positive or negative expression on someone else's face. Therefore, when treated with BoNT-A, patients can both experience fewer negative emotions themselves and spread less negativity via these two hypotheses.

Botulinum Toxin: Muscle Paralysis and Emotion Regulation

BoNT-A is widely used in dermatology to reduce facial wrinkles and improve emotional well-being. By relaxing muscles like the corrugator and orbicularis oculi, BoNT-A smooths frown lines and crow's feet while potentially modulating emotional experiences through the facial feedback hypothesis, which links muscle activity to mood. Studies show that glabellar BoNT-A reduces negative emotions like sadness and anger, enhances positive emotional experiences, and decreases activity in the amygdala. Conversely, when used to treat lateral canthal lines, patients experience reduced positive emotional affect. This must be considered when treating both glabellar and lateral canthal lines, as their emotional benefits cancel out. BoNT-A also minimizes wrinkles that may misrepresent emotions, reducing biases and enhancing communication.

Figure 2. Botulinum toxin can both dampen patients' negative emotions and spread positive emotion to others.



RESULTS/DISCUSSION

Implications in Clinical Depression

Clinical studies have shown that glabellar BoNT-A can reduce anxious, depressive, and irritable moods by decreasing amygdala activity. Meta-analyses have highlighted BoNT-A's mood-enhancing effects and its potential as a simple, accessible mental health solution, particularly in resource-limited settings, dating back to the first clinical study for depression in 2006. These studies have placed particular emphasis on the role that BoNT-A has in patients with treatment-resistant depression.

CONCLUSION

Frowning is driven by muscles of the glabellar complex, which contract to display negative emotions. Frowning produces frown lines that can be treated by BoNT-A. BoNT-A smooths frown lines and crow's feet via muscle paralysis. Importantly, depending on the muscles paralyzed, the use of BoNT-A can result in decreased negative emotions felt and displayed or also decreased positivity felt and displayed.

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